

Figure 1

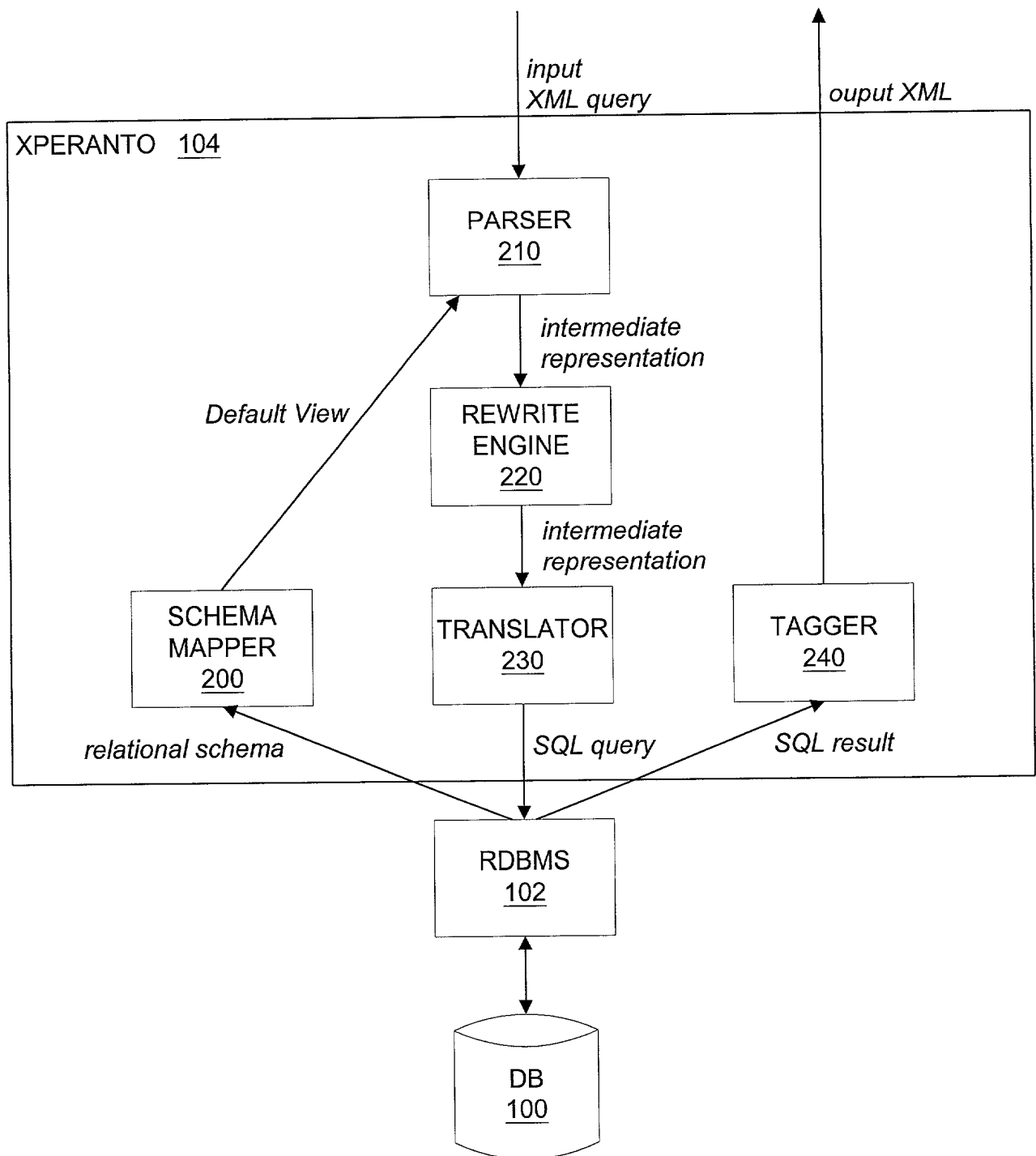


Figure 2

DEPT TABLE — 300

DNO	NAME	SIZE
1	Finance	100
2	Marketing	200
3	Sales	50
...		

Figure 3

EMP TABLE — 310

DNO	ENO	NAME	AGE
1	1	J. Skolem	50
2	2	L. Hubbard	33
...			

Default XML View of the DEPT Table — 320

```
<DEPT>
  <ROW>
    <DNO>1</DNO><NAME>Finance</NAME><SIZE>100</SIZE>
  </ROW>
  <ROW>
    <DNO>2</DNO><NAME>Marketing</NAME><SIZE>200</SIZE>
  </ROW>
  <ROW>
    <DNO>3</DNO><NAME>Sales</NAME><SIZE>50</SIZE>
  </ROW>
  ...
</DEPT>
```

Default XML View of the EMP Table — 330

```
<EMP>
  <ROW>
    <DNO>1</DNO><ENO>1</ENO><NAME>J. Skolem</NAME><AGE>50</AGE>
  </ROW>
  <ROW>
    <DNO>2</DNO><ENO>2</ENO><NAME>L. Hubbard</NAME><AGE>33</AGE>
  </ROW>
  ...
</EMP>
```

Query Over the Default View

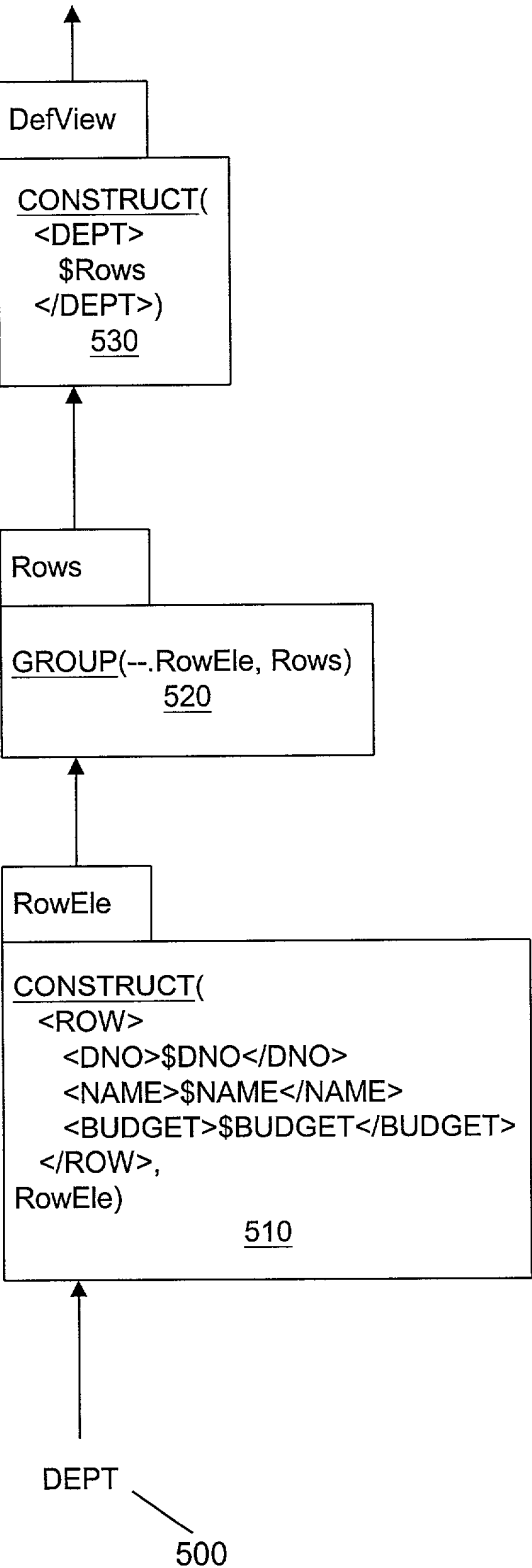
```
WHERE
  <DEPT>
    <ROW>
      <DNO>$DNO</DNO><NAME>$DNAME</NAME>
      <SIZE>$DSIZE</SIZE>
    </ROW>
  </DEPT>IN DefaultView,
  $DSIZE>75
CONSTRUCT
  <BIGDEPT>
    <NAME>$DNAME</NAME>
    <SIZE>$DSIZE</SIZE>
    {WHERE
      <EMP>
        <ROW><DNO>$DNO</DNO><NAME>$ENAME</NAME></ROW>
      </EMP>IN DefaultView
    CONSTRUCT
      <EMP><NAME>$ENAME</NAME></EMP>}
  </BIGDEPT>
```

XML Produced by the Query

```
<BIGDEPT>
  <NAME>Finance</NAME>
  <SIZE>100</SIZE>
  <EMP><NAME>J.Skolem</NAME></EMP>
  ...
</BIGDEPT>
<BIGDEPT>
  <NAME>Marketing</NAME>
  <SIZE>200</SIZE>
  <EMP><NAME>L. Hubbard</NAME></EMP>
  ...
</BIGDEPT>
...
```

Figure 4

Intermediate Representation for the
Default View of the DEPT Table



Output of Each Operation

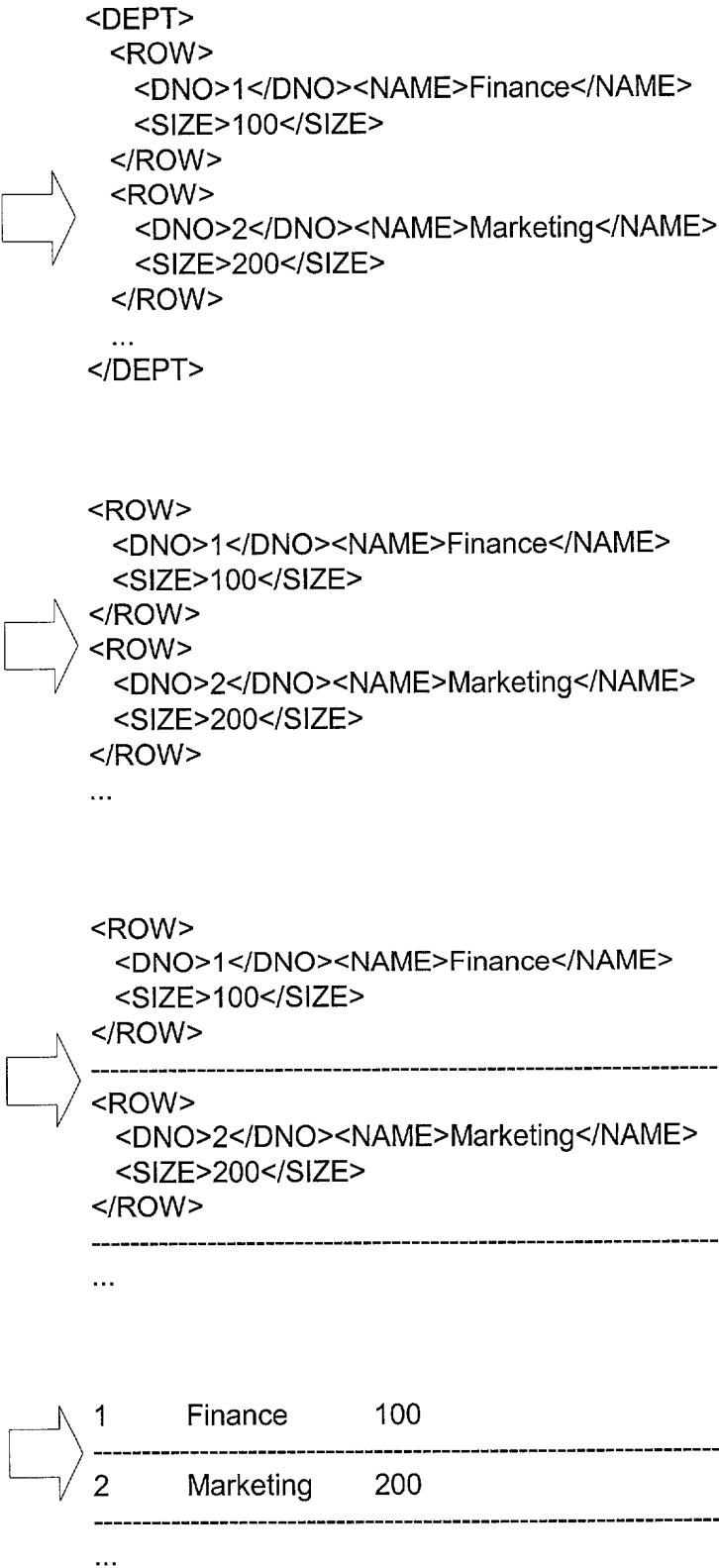


Figure 5

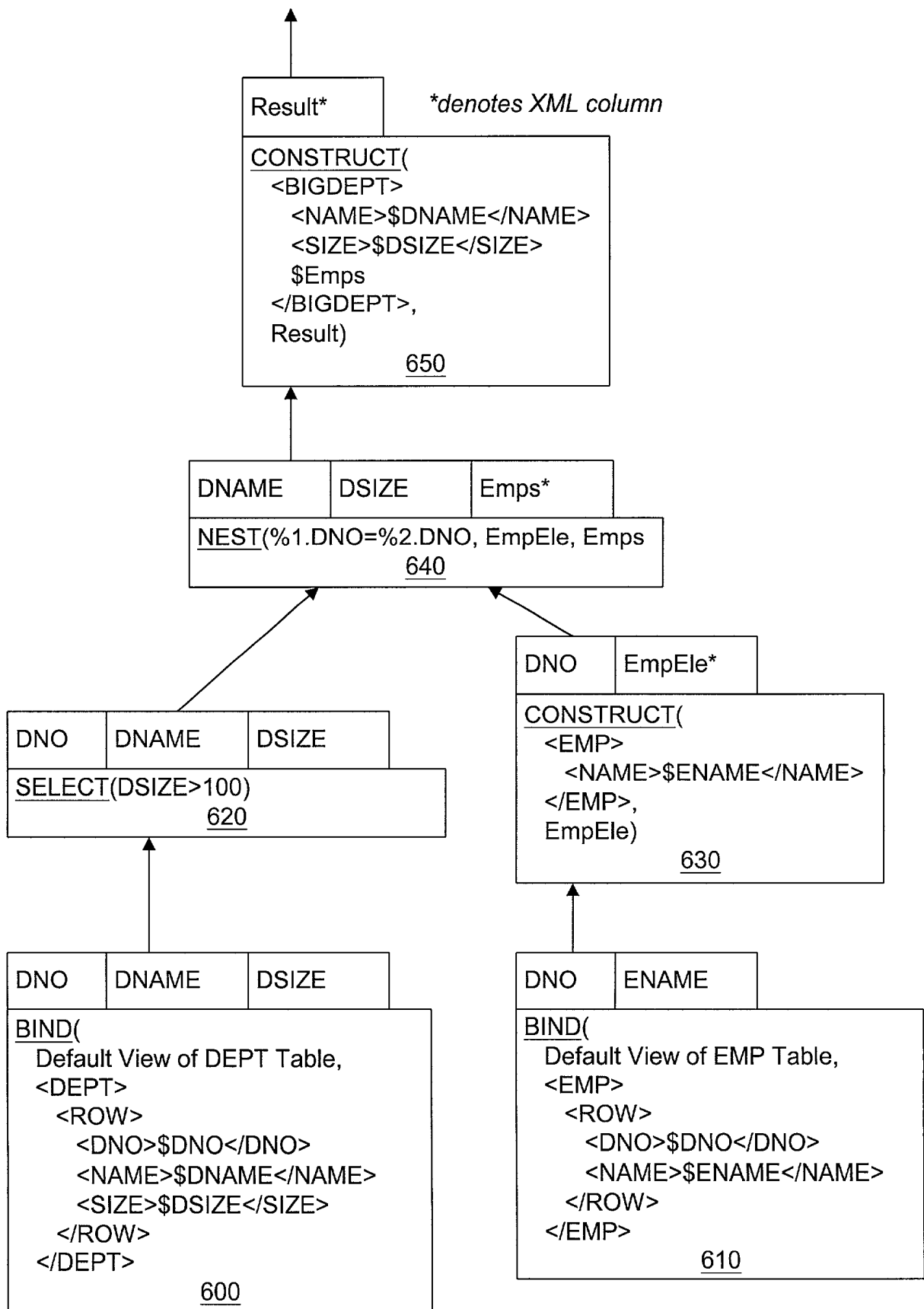


Figure 6

740

**denotes XML column*

Result*

```

CONSTRUCT(
  <BIGDEPT>
    <NAME>$DNAME</NAME>
    <SIZE>$DSIZE</SIZE>
    $Emps
  </BIGDEPT>,
  Result)

```

720

DNAME

DSIZE

Emps*

GROUP(DNO, EmpEle, Emps)

710

DNO

DNAME

DSIZE

EmpEle*

```

CONSTRUCT(
  <EMP>
    <NAME>$ENAME</NAME>
  </EMP>,
  EmpEle)

```

700

730

DNO

DNAME

DSIZE

ENAME

JOIN(%1.DNO=%2.DNO)

DNO

DNAME

DSIZE

EMP

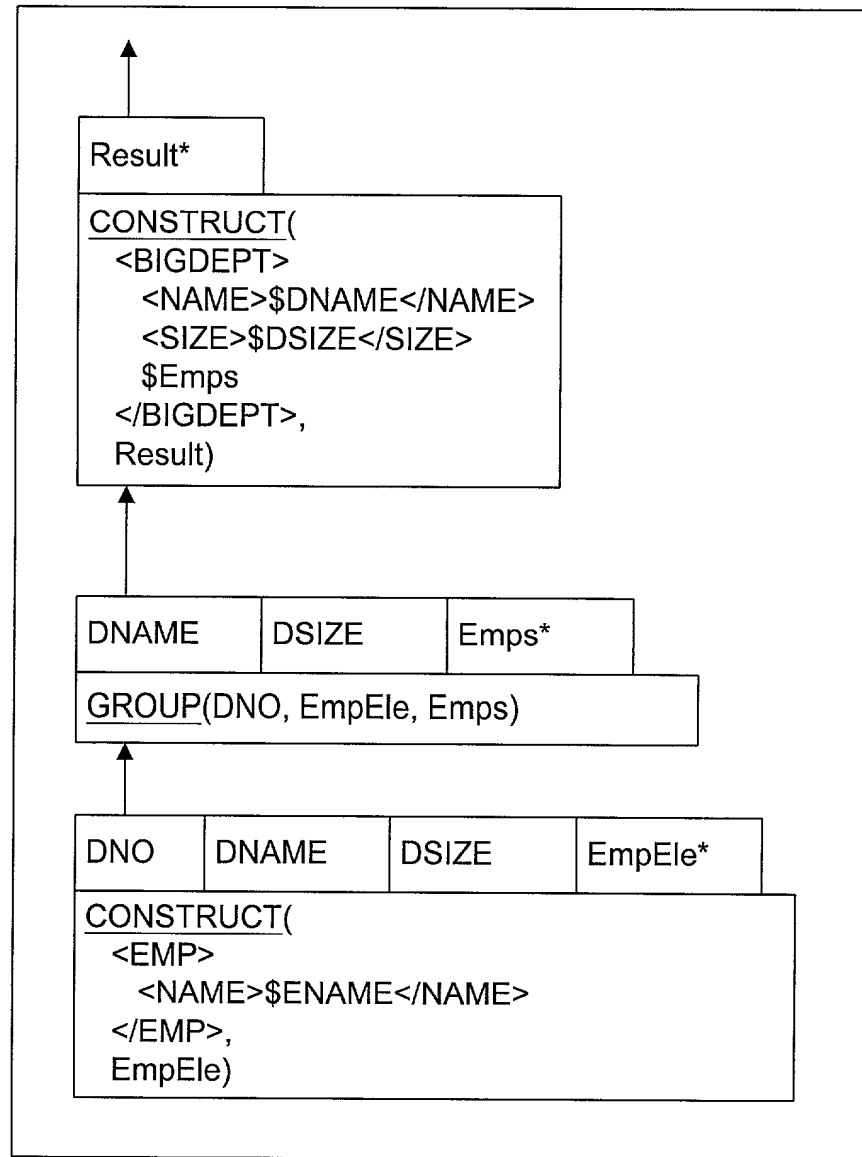
SELECT(DSIZE>100)

DEPT

Figure 7

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740



SQL Query 800

730

```
select D.DNO as DNO, D.NAME as DNAME,
       D.SIZE, as DSIZE, E.NAME as ENAME
from DEPT D left join EMP E on D.DNO=E.ENO
where D.SIZE>100
```

Figure 8

Employee

<u>WORKDEPT</u>	<u>ENO</u>	<u>LASTNAME</u>
1	1	Haas
2	2	Thompson
3	3	Kwan
1	4	Lucchessi
1	5	O'Connell
3	6	Quintana
3	7	Nicholls

Figure 9a

Default XML View of the Employee Table (DefaultEmployee)

```
<EMP>
  <ROW>
    <WORKDEPT>1</WORKDEPT><ENO>1</ENO><LASTNAME>Haas</LASTNAME>
  </ROW>
  <ROW>
    <WORKDEPT>2</WORKDEPT><ENO>2</ENO><LASTNAME>Thompson</LASTNAME>
  </ROW>
  <ROW>
    <WORKDEPT>3</WORKDEPT><ENO>3</ENO><LASTNAME>Kwan</LASTNAME>
  </ROW>
  <ROW>
    <WORKDEPT>1</WORKDEPT><ENO>4</ENO><LASTNAME>Lucchessi</LASTNAME>
  </ROW>
  <ROW>
    <WORKDEPT>1</WORKDEPT><ENO>5</ENO><LASTNAME>O'Connell</LASTNAME>
  </ROW>
  <ROW>
    <WORKDEPT>3</WORKDEPT><ENO>6</ENO><LASTNAME>Quintana</LASTNAME>
  </ROW>
  <ROW>
    <WORKDEPT>3</WORKDEPT><ENO>7</ENO><LASTNAME>Nicholls</LASTNAME>
  </ROW>
</EMP>
```

Figure 9b

Department

DEPTNO	DEPTNAME	SIZE
1	Spiffy Computer	3
2	Planning	1
3	Information Center	3
4	Development Center	0

Figure 10a

Default XML View of the Department Table (DefaultDepartment)

```
<DEPT>
  <ROW>
    <DEPTNO>1</DEPTNO><DEPTNAME>Spiffy Computer </DEPTNAME><SIZE>3</SIZE>
  </ROW>
  <ROW>
    <DEPTNO>2</DEPTNO><DEPTNAME>Planning</DEPTNAME><SIZE>1</SIZE>
  </ROW>
  <ROW>
    <DEPTNO>3</DEPTNO><DEPTNAME>Information
Center</DEPTNAME><SIZE>3</SIZE>
  </ROW>
  <ROW>
    <DEPTNO>4</DEPTNO><DEPTNAME>Development
Center</DEPTNAME><SIZE>0</SIZE>
  </ROW>
</DEPT>
```

Figure 10b

Query Over Default Views

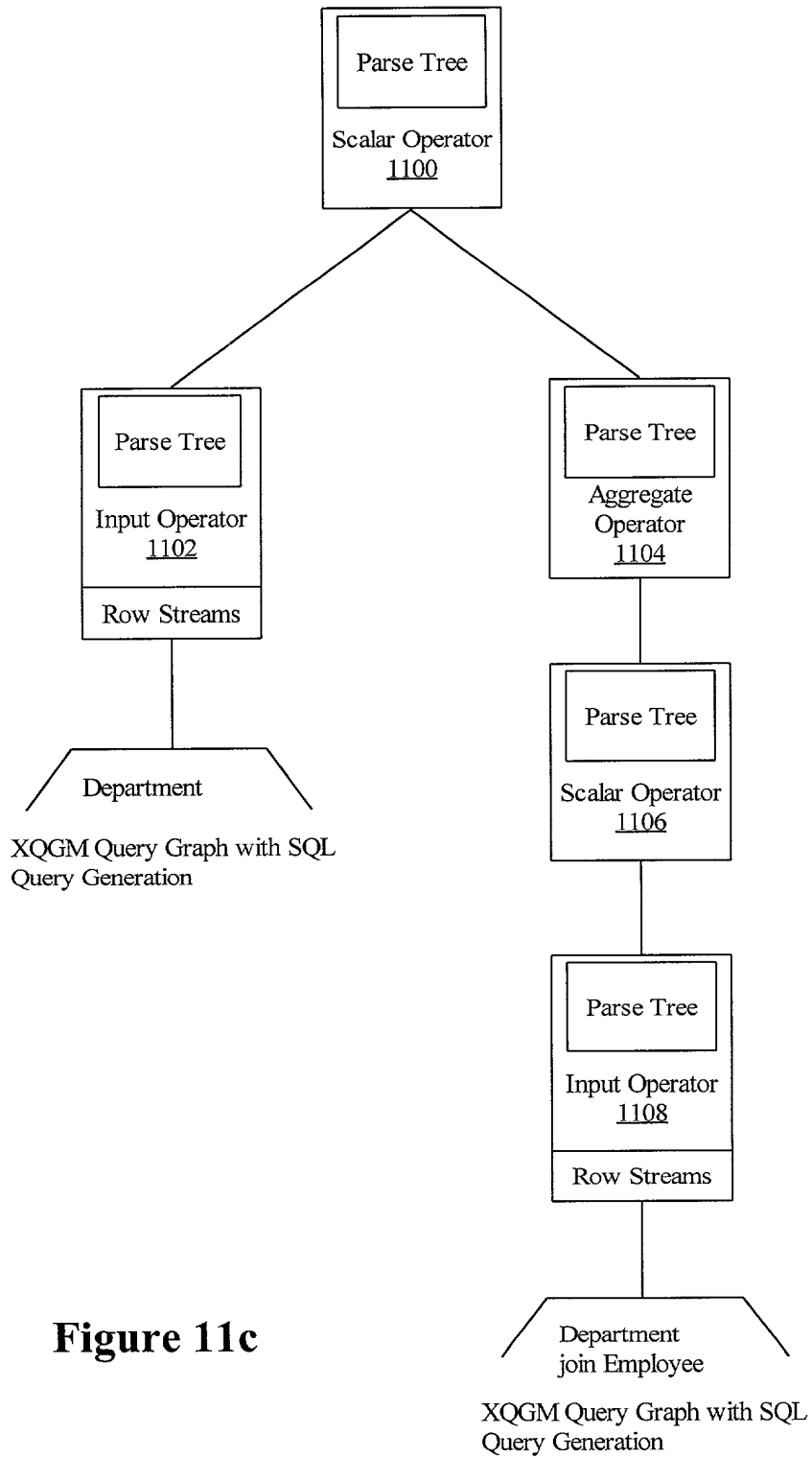
```
WHERE
  <DEPT>
    <ROW>
      <DEPTNO> $DEPTNO </DEPTNO> <DEPTNAME> $DEPTNAME </DEPTNAME>
      <SIZE> $SIZE </SIZE>
    </ROW>
  </DEPT> IN DefaultDepartment
CONSTRUCT
  <dept name = $DEPTNAME>
    <emplist>
      {WHERE
        <ROW>
          <WORKDEPT> $DEPTNO </WORKDEPT> <ENO> $ENO </ENO>
          <LASTNAME> $ENAME </LASTNAME>
        </ROW>
        </EMP> IN DefaultEmployee
      CONSTRUCT
        <employee> <name> $ENAME </name> </employee>
      }
    </emplist>
  </dept>
```

Figure 11a

Result of Query

```
<dept name="SPIFFY COMPUTER">
  <emplist>
    <employee><name>HAAS</name></employee>
    <employee><name>LUCCHESSI</name></employee>
    <employee><name>O'CONNELL</name> </employee>
  </emplist>
</dept>
<dept name="PLANNING">
  <emplist>
    <employee> <name>THOMPSON</name></employee>
  </emplist>
</dept>
<dept name="INFORMATION CENTER">
  <emplist>
    <employee><name>K WAN</name></employee>
    <employee><name>QUINTANA</name></employee>
    <employee><name>NICHOLLS</name></employee>
  </emplist>
</dept>
<dept name="DEVELOPMENT CENTER">
  <emplist >
  </emplist>
</dept>
```

Figure 11b



Sorted Outer Union SQL Query

```
select q4.c2, q4.c3, q4.c4
from (select q3.DEPTNO, q3.DEPTNAME, cast (null as VARCHAR(15)), 0 } 2
      from DEPARTMENT AS q3

union all
select q2.DEPTNO, cast (null as VARCHAR(29)), q2.LASTNAME, 1
from (select q1.LASTNAME, q5.DEPTNO
      from EMPLOYEE AS q1,
           DEPARTMENT AS q5
      where (q5.DEPTNO = q1.WORKDEPT))
      AS q2(LASTNAME, DEPTNO))
AS Q4(DEPTNO, DEPTNAME, LASTNAME, INDICATOR)
order by DEPTNO, INDICATOR }
```

Figure 12a

Result of 1

DEPTNO	'NULL'	LASTNAME	'INDICATOR'
1	null	Haas	1
2	null	Thompson	1
3	null	Kwan	1
1	null	Lucchessi	1
1	null	O'Connell	1
3	null	Quintana	1
3	null	Nicholls	1

Figure 12b

Result of 2

<u>DEPTNO</u>	<u>DEPTNAME</u>	<u>'NULL'</u>	<u>'INDICATOR'</u>
1	Spiffy Computer	null	0
2	Planning	null	0
3	Information Center	null	0
4	Development Center	null	0

Figure 12c

Result of Union

<u>DEPTNO</u>	<u>DEPTNAME</u>	<u>LASTNAME</u>	<u>INDICATOR</u>
1	Spiffy Computer	null	0
2	Planning	null	0
3	Information Center	null	0
4	Development Center	null	0
1	null	Haas	1
2	null	Thompson	1
3	null	Kwan	1
1	null	Lucchessi	1
1	null	O'Connell	1
3	null	Quintana	1
3	null	Nicholls	1

Figure 12d

Result of Order

DEPTNO	DEPTNAME	LASTNAME	INDICATOR
1	Spiffy Computer	null	0
1	null	Haas	1
1	null	Lucchessi	1
1	null	O'Connell	1
2	Planning	null	0
2	null	Thompson	1
3	Information Center	null	0
3	null	Kwan	1
3	null	Quintana	1
3	null	Nicholls	1
4	Development Center	null	0

Figure 12e

Result of Sorted Outer Union Query

DEPTNAME	LASTNAME	INDICATOR
Spiffy Computer	null	0
null	Haas	1
null	Lucchessi	1
null	O'Connell	1
Planning	null	0
null	Thompson	1
Information Center	null	0
null	Kwan	1
null	Quintana	1
null	Nicholls	1
Development Center	null	0

Figure 12f

Node Strip SQL Query

```
select q1.DEPTNO, q1.DEPTNAME } 1
from DEPARTMENT AS q1
order by q1.DEPTNO

select q2.LASTNAME, q2.DEPTNO } 2
from (select q3.LASTNAME, q4.DEPTNO
      from EMPLOYEE AS q3,
           DEPARTMENT AS q4
      where (q4.DEPTNO = q3.WORKDEPT))
AS q2(LASTNAME, DEPTNO)
order by q2.DEPTNO
```

Figure 13a

Result of Node Strip (1)

DEPTNO	DEPTNAME
1	Spiffy Computer
2	Planning
3	Information Center
4	Development Center

Figure 13b

Result of Node Strip (2)

LASTNAME	DEPTNO
Haas	1
Lucchessi	1
O'Connell	1
Thompson	2
Kwan	3
Quintana	3
Nicholls	3

Figure 13c

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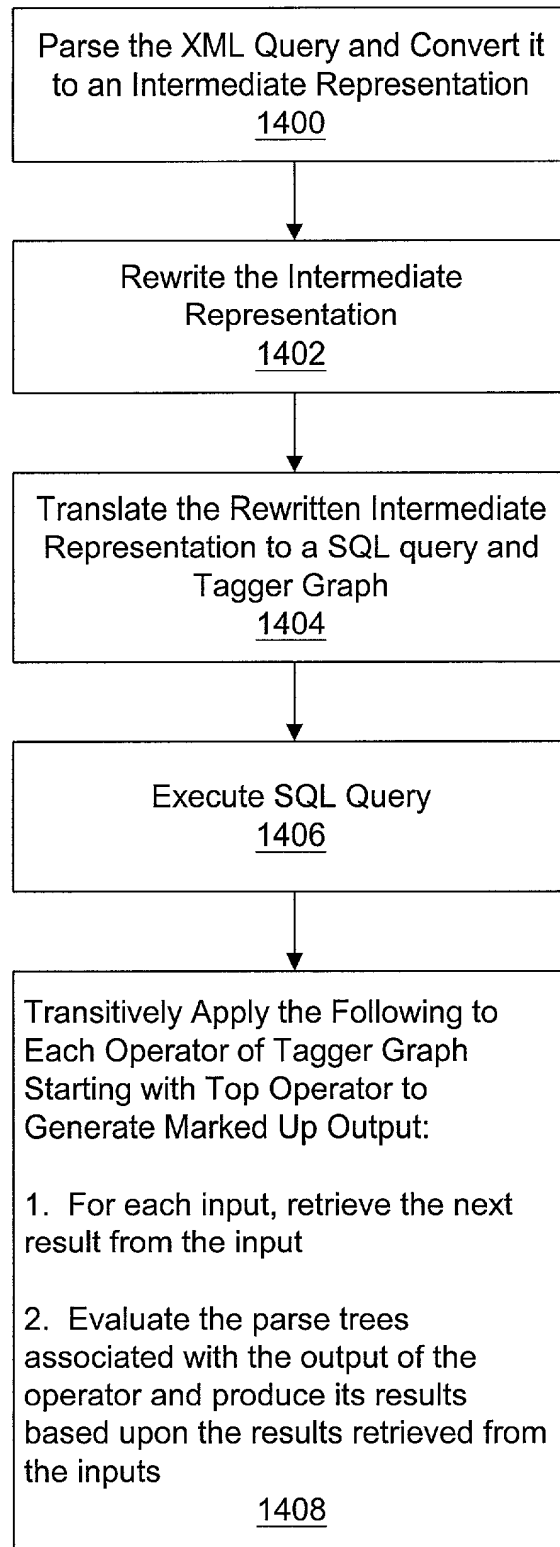


Figure 14